Dennis, M.S.

A study of leaves.

1898.

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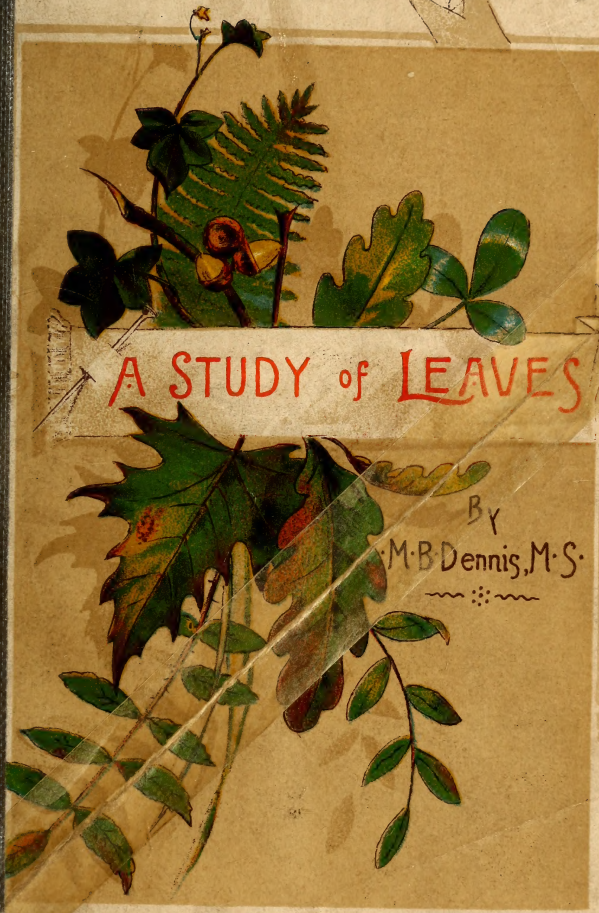
A STUDY of LEAVES
By
M·B·Dennis, M·S·

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A STUDY OF LEAVES

BY

MARY B. DENNIS, M.S.

DIRECTOR CHAUTAUQUA WALKING SCIENCE CLUB

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1898

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TO THE CHAUTAUQUA WALKING SCIENCE CLUB
THIS LITTLE STUDY IS PRESENTED
IN THE LOVE OF NATURE AND OF NATURE'S GOD

M. B. D.

PREFACE.

THAT a club of young people could have a delightful time rambling through the woods in search of leaves, flowers, and insects, was a happy conception. It did not take long to organize the club, for the young people at Chautauqua in the summer of '86 were agog for pleasure. With butterfly-net and collecting-jar, trowel, microscope, and tin basket, the band of naturalists started forth, their chubby cheeks glowing beneath big hats.

The kindly woods sang a welcome, the doomed bugs came out to greet them, and soon the children were running, catching, picking, and questioning, while the birds caught the spirit of their merry glee and joined in the chorus. Every day's ramble brought new wonders, new joys; and the vacation passed all too soon.

A serious difficulty, however, arose. It was awkward to carry books of reference, and they were anxious to know all about the treasures found. This little book grew out of such a necessity.

It contained no more facts than were necessary for answering questions that might arise concerning leaves, and was a dainty volume which might be pinned to the belt or carried in the pocket. So, during the next summer, the club was better equipped, and consequently accomplished more scientific work.

Teachers were attracted by the novel and unique character of the book, and requested it for use in their classes in Botany.

To supply this demand it has been placed in the hands of the publisher, and is sent forth on its mission with the hope that it may be the means of teaching many, both young and old, that "there is a soul in every leaf."

THE AUTHOR.

CONTENTS.

	PAGE
Preface	5
Introduction. Dr. CHARLES C. ABBOTT	9
Leaves	11
Arrangement	12
Parts	14
Blade	14
Venation	16
Net-veined Leaves	17
Parallel-veined Leaves	18
Base	19
Apex	20
Margin	21
Surface	22
Petiole	23
Stipules	24
Classes	25
Shapes of Entire Simple Leaves	26
Forms of Lobed Simple Leaves	28
Classes of Compound Leaves	29

PAGE

Pinnately Compound 30
Palmately Compound 31
Leaf-Buds 33
Vernation 34
Transformations of the Leaf 38
Leaves Asleep 41
Duration 42
How to Press Leaves 43
How to Draw Leaves 44
How to Paint Leaves 45
How to Print Leaves 46
How to Skeletonize Leaves 47
Notes upon Leaf-Analysis 48
Model for Leaf-Analysis 49

INTRODUCTION.

KNOWLEDGE is power, as the world well knows. It is happiness, likewise, and no form of it is more productive of healthful pleasure than a knowledge of NATURE.

Every rock, tree, insect, bird, and mammal speaks to us when we meet it; yet, how generally we hurry by, without even so much as a nod of recognition! This is an error that no young person should make; but rather let him make friends with Nature.

Every object of the woods and fields offers to tell its story, and a wondrous one it is, telling it in its own way, but never speaking in a strange tongue.

Few there are, I imagine, who pass along a street and see nothing in the shop-windows; yet thousands can pass over miles of open country and admit that they have seen nothing! This sad fact can best be obviated by cultivating the powers of observation when young; and this training, in after-years, will prove of inestimable value in whatever station of life one may find himself. Man is too

dependent upon Nature to afford to be ignorant of her ways.

At the outset, my young friends will find that they must take some things at second-hand: and I offer one assertion based upon the opinions of a whole army of gray-beards. It is this: there is far more of interest, far more of the marvelous, far more of the truly beautiful, in the country than in the town.

See, now, as opportunity affords, if this is not true. Gather a leaf, a flower, a butterfly, or a crystal, and compare this handiwork of Nature with that of the most skillful artists. I should be pleased to hear from that child who, after doing this, thinks otherwise.

There's not a flower that skyward lifts
Its laughing face to greet the sun;
There's not a leaf that earthward drifts,
Sad signal that its race is run,
But hath a potent part to play,
Unmeaning, until led to look
Beyond the present, where as day,
As pages of a printed book,
The truth outstands, and happy he,
Who hath been rightly taught to see.

CHARLES C. ABBOTT.

PROSPECT HILL, TRENTON, N. J.,
December 8, 1887.

LEAVES.

THE beautiful leaves, so varied in their forms and hues, are essential to the life of plants. No more can plants flourish without them than can animals without lungs and stomach, for they breathe through their leaves and digest their food in them.

And when we consider that every part of the *flower* is but a *leaf*, rolled or twisted or changed somehow in form and color, we more fully appreciate their importance. Yes, not only do they furnish the leafy umbrage of the forest, but also the flowers which, whether crowning the wayside with beauty or smiling in a sick-room, whether adorning the halls of splendor or pleading in some loathsome prison, everywhere breathe forth the fragrance of divine love.

From the realm of Infinite Thought they come inviting investigation; and by studying them we grow not only wiser, but also better and happier.

ARRANGEMENT.

According to their arrangement upon the stem, leaves are—

Opposite, two opposite each other at a joint.

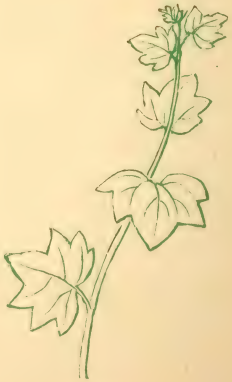
Alternate, one at a joint

Radical, seeming to grow from the root.

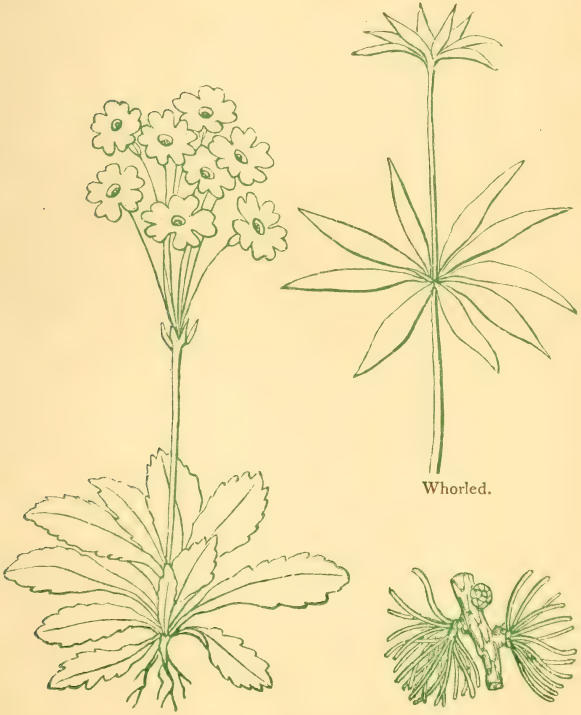
Whorled, several at a joint.

Fascicled, tufted.

Opposite.



Alternate.



Whorled.

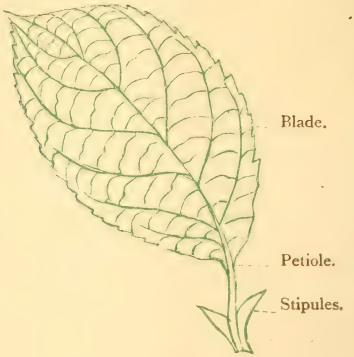
Radical.

Fascicled.

PARTS.

The parts of a complete leaf are—

Blade, the flattened green part.
Petiole, the stem.
Stipules, small leaves at the base.



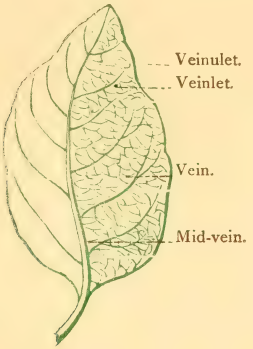
BLADE.

The blade carries on the important work of digestion and breathing. Air enters the plant

through little mouths in the blade called *stomatæ*, which open in moist air and close in dry.

In studying the blade we consider its veins, base, apex, margin, and surface.

The veins form the framework, just as the bones constitute the skeleton of the human body. The



largest one, in the center, is the *mid-vein.* Branches from the mid-vein are *veins;* branches from the veins are *veinlets;* and from the veinlets are *veinulets.* The green tissue between the veins is called the parenchyma. Sometimes the parenchyma is so fleshy that the veins are hidden in it.

VENATION.

According to the distribution of the veins, leaves are Net-veined or Parallel-veined—

Net-veined, when the veins branch and cross one another, forming an irregular network.

Parallel-veined, when the veins run from the base to the apex, or from the mid-vein to the margin, without branching.

Parallel-veined.

Net-veined.

Nearly all the leaves of early spring flowers and the grasses and herbs are parallel-veined, while those of trees and woody shrubs are net-veined. And yet many of the parallel-veined are evergreen, enduring heroically the freezing winds of winter.

NET-VEINED LEAVES.

Net-veined, or Reticulate, Leaves are of two sorts—

Feather-veined, when there is but one mid-vein in the center which sends off veins on both sides, like the plume from the shaft of a feather.

Palmate-veined, when three or more mid-veins start from the petiole. This resembles the creases in the palm of the hand, hence called palmate.

Net Feather-veined.

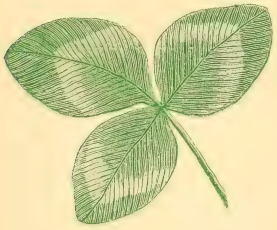
Net Palmate-veined.

PARALLEL-VEINED LEAVES.

Parallel-veined leaves are also of two sorts, Feather-veined and Palmate-veined.

In **Feather-veined** the veins extend from the *mid-vein*, without branching, to the margin.

In **Palmate-veined** the veins all extend from the *petiole* without branching.



Parallel Feather-veined.

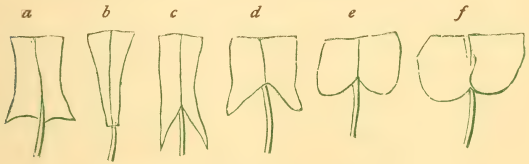
Parallel Palmate-veined.

The flowers of plants having net-veined leaves are generally in fours or fives; that is, they have four or five sepals, the same number of petals, etc.

The flowers of plants having parallel-veined leaves are generally in threes, or some number of times three—as six, nine, twelve, etc. It is very rare to find a three-parted flower with net-veined leaves.

BASE.

The **Base** is the lower end of the leaf. The following are the most common forms:



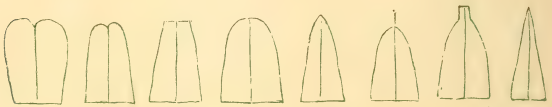
a. **Hastate**—Halberd-shaped.
b. **Tapering**—Gradually pointed.
c. **Sagittate**—Arrow-shaped.
d. **Auriculate**—Ear-shaped.
e. **Cordate**—Heart-shaped.
f. **Reniform**—Kidney-shaped.

When the bases of two leaves grow together, they are *connate* (*a*).

When the base of a leaf grows beyond the stem and closes around it, it is *perfoliate* (*b*).

APEX.

The **Apex** is the upper end of the leaf. The following forms are common :



a *b* *c* *d* *e* *f* *g* *h*

a. **Obcordate,** like an inverted heart.
b. **Emarginate,** with an inward notch.
c. **Truncate,** cut off square.
d. **Obtuse,** rounded at the point.
e. **Acute,** gradually pointed.
f. **Mucronate,** with a spiny point.
g. **Cuspidate,** abruptly pointed.
h. **Acuminate,** with a long point.

Sometimes the apex is developed into a tendril for the purpose of climbing (Fig. *x*), when the leaf is said to be Cirrous.

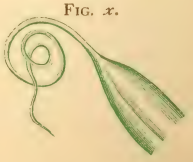


FIG. *x*.

MARGIN.

The **Margin** is the edge of the blade. It is entire or toothed. An entire margin is even. A toothed margin is notched. There are numerous varieties, as given below. When the notches themselves are toothed, the leaf is doubly *serrate*, doubly *dentate*, etc.

Entire.

Dentate (Toothed).

Serrate (Saw-toothed).

Crenate.

Doubly Crenate.

Repand (Wavy).

Erose (Jagged).

Ciliated (Hairy).

SURFACE.

Hairs are a leaf's weapons of defense. The microscope reveals their varied forms.

Hairs of plants much magnified.

Glands are cells at the base of hairs containing watery liquid or oil. Sometimes the gland contains a poisonous liquid and sends it through the hairs, forming a sting like that of the Nettle.

The following terms are applied:

Glabrous—Smooth, without hairs.
Tomentose—Woolly, with dense hairs.
Silky, soft—With dense, soft hairs.
Pruinous—Covered with blue powder.
Punctate—Dotted with glands.

PETIOLE.

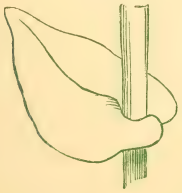
The **Petiole** is the stem of the leaf. A leaf having a petiole is *petiolate*, and one without a petiole, growing directly from the main stalk, is *sessile*.

When the petiole grows from the center of the leaf, on the under side, it is *peltate*.

Petiolate. Sessile. Peltate.

When the base of the leaf folds around the petiole, it is *clasping*, or amplexicaul.

When the petiole grows to the plant-stem, the leaf is *decurrent*.



Amplexicaul.

Decurrent.

STIPULES.

Stipules are small, leaf-like organs at the base of some leaves. Leaves having stipules are said to be *stipulate*; those without them are *exstipulate*.

The stipules may be—

Free (*a*), looking like perfect leaves, and assisting the leaves in their work.

Adnate (*b*), growing to the petiole

Sheathing (*c*), surrounding the petiole like a hood.

Thread-like (*d*), long and slender.

CLASSES.

Leaves are **Simple** or **Compound.** A simple leaf consists of one blade. This blade may be entire or lobed.

Entire.

Lobed.

A compound leaf has several blades, each of which is called a leaflet.

The difference between a deeply lobed simple leaf and a compound leaf is that the lobes of a simple leaf never extend entirely to the mid-vein, while the leaflets of a compound leaf arise directly from the mid-vein or the petiole.

Compound Leaf.

SHAPES OF ENTIRE SIMPLE LEAVES.

Simple leaves are of three distinct groups:

1. Broadest at base.

Ovate.

Sagittate.

Reniform.

Cordate.

Hastate.

Deltoid.

Lanceolate.

Awl-shape.

Horn-shape.

Lunate.

2. Broadest in middle.

Orbicular.

Oval

Elliptical.

Oblong.

3. Broadest at apex.

Obcordate.

Cuneate.

Obovate.

Lyrate.

Oblanceolate.

Panduriform.

Spatulate.

FORMS OF LOBED SIMPLE LEAVES.

The forms of **lobed leaves** are numerous and beautiful.

Palmate.

Palmisected.

Pedate.

Runcinate.

Pinnatifid.

Bipinnatifid.

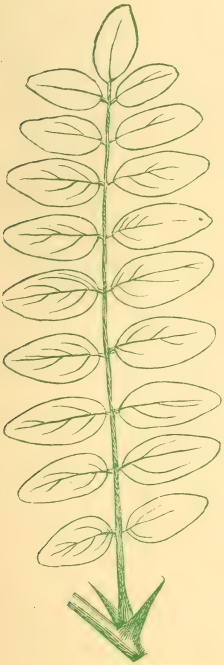
Spinous.

Squarrose.

Laciniate.

CLASSES OF COMPOUND LEAVES.

Pinnate and **Palmate** venation give rise to two classes of compound leaves. A pinnately compound leaf has the mid-vein extending from base to apex, bearing a row of leaflets on each side. Palmately compound leaves have the leaflets all jointed to the petiole.



Pinnately compound.

Palmately compound.

PINNATELY COMPOUND.

Unequally Pinnate—Ending in one leaflet.

Equally Pinnate—Ending in two leaflets.

Interruptedly Pinnate—Large and small leaflets.

Bi-Pinnate—With pinnate leaflets.

Tri-Pinnate—Bi-pinnate leaflets pinnate.

Lyrate—Ending in one large leaflet with small ones below.

Lyrate.

Unequal.

Interrupted.

Equal.

Bi-Pinnate.

Tri-Pinnate.

PALMATELY COMPOUND.

Palmately Compound leaves are named according to the number of leaflets.

Binate—Having two leaflets.
Ternate—Having three leaflets.
Quinate—Having five leaflets.
Septinate—Having seven leaflets.
Multifoliate—Having more than seven leaflets.
Bi-Ternate—Having three ternate leaflets.

Binate.

Ternate.

Quinate.

Septinate.

Multifoliate.

Bi-Ternate.

LEAF-BUDS.

New branches are developed from buds growing in the joints of leaves, called *axillary* buds. As the branch pushes out, it bears a bud upon the end of it, called the *terminal* bud. Thus every axillary bud becomes terminal.

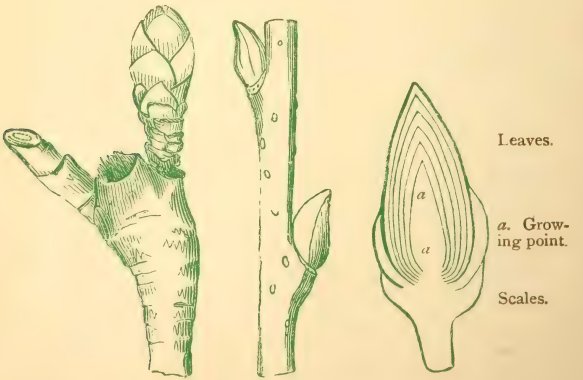
Terminal Bud.

Some people pride themselves upon their skill in packing trunks ; but Mother Nature excels all her children in this art. She uniquely folds away a gigantic oak in an acorn, and the mightiest branches are tucked up in a tiny bud !

VERNATION.

The folding of leaves in the bud is called *vernation.* It is interesting to observe the manner in which they are placed in relation to one another, and also to notice whether each leaf in itself is flat, folded, or rolled.

If winter buds be examined, it will be found how carefully they are protected by scales. Sometimes they are covered with varnish or a dense coat of hairs to keep out Jack Frost.

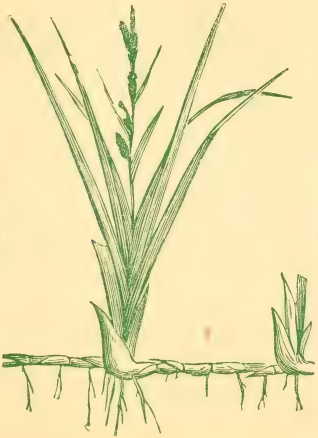


Scale-covered Buds.

To study the relation of leaves to one another, cut off the top of the bud and examine the cut edges with a magnifying-glass. It will be found that they are either folded so that the edges barely touch, when they are called *valvate;* or the edges overlap like the coats of an onion, when they are called *imbricate.*

When leaves continue to overlap at the base after they have developed, they are *equitant.*

Valvate.



Equitant.

Imbricate.

To find out how each leaf is folded or rolled, watch them as they begin to peep out from the bud.

The following are some of the ingenious methods of packing which Dame Nature has invented :

Circinnate.

Reclinate.

Conduplicate.

Plicate.

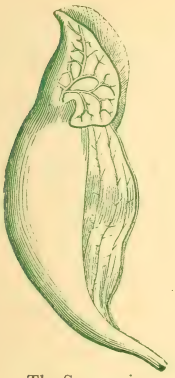
Convolute.

TRANSFORMATIONS OF THE LEAF.

Leaves sometimes assume curious and interesting forms, which are very unlike the original leaf. These disguises are called *transformations.*

The **Venus Flytrap** consists of a leaf divided into two lobes which can close together as if attached by hinges. It sends forth a sweet liquid of which insects are very fond; but, when a poor fly alights upon it, the trap instantly closes and impales him on its sharp prickles.

The Venus Flytrap.



The Sarracenia.

The **Pitcher-Plants** roll their leaves for the purpose of holding water. The **Sarracenia** drowns insects in its pitcher, preventing them from escaping by stiff hairs which turn inward at its mouth.

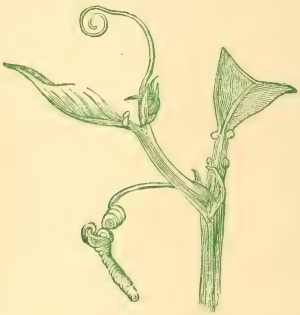
The pitcher is formed by the edges of the winged petiole uniting.

Nepenthes has a cover to its pitcher, to prevent the water from evaporating. This lip opens when it rains, and closes in dry weather. The water is not for killing insects, but to nourish the plant.

Air-Bladders are little sacks filled with air for the purpose of holding water-plants up near the surface. They are generally formed of leaf-lobes.

The Nepenthes.

Tendrils are leaves transformed into long, slender threads, which assist vines in climbing.



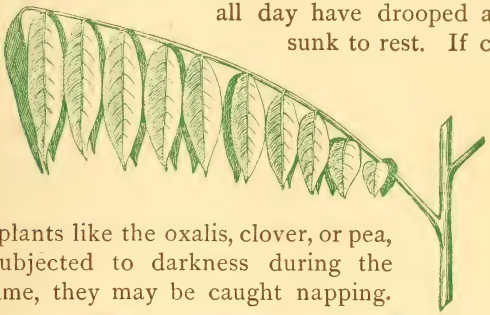
Tendrils.

Spines and **prickles** are transformed leaves, while **thorns** are transformed branches.

But most remarkable of all is the fact that all **flowers** are transformed leaves. Sometimes the parts of the flower prove this by changing back to leaves. Occasionally a rose blooms in all its queenly beauty as to form, but with *green* petals marked with veins, proving that they are true leaves.

LEAVES ASLEEP.

Leaves never tell their dreams; but that they do go to sleep is an open secret. Here is a compound leaf asleep. The little leaflets which were in motion all day have drooped and sunk to rest. If cer-



tain plants like the oxalis, clover, or pea, be subjected to darkness during the daytime, they may be caught napping.

Lupinus awake.

Lupinus asleep.

DURATION.

"Thou poor leaf, so sear and frail,
Sport of every wanton gale,
Whence and whither dost thou fly,
Through the bleak, autumnal sky?"

When they have finished their work, leaves commonly change to brilliant hues and loosen their hold upon the twigs which they have served so faithfully. Then the chilly winds sweep them to the ground, and blow them to and fro, causing them to rustle their own sad funeral knell. The grief-laden sky, the mellow mists, the melancholy moanings of the forest are, no doubt, Nature's expressions of grief at their departure. And even in dying they do not forget their mission of blessing the world, for by their decay the soil is revivified and enriched.

Leaves which drop after one season are *deciduous*. Those which remain for several seasons, or until new ones are formed, are *persistent*, and the plant is *evergreen*.

HOW TO PRESS LEAVES.

Place the fresh leaves between layers of newspaper, in a book, and subject to heavy pressure for about seven days. In absence of a botanical press, pressure may be secured by slipping the book under a trunk, or by piling books upon it. It is better to change the newspapers two or three times during the operation, as the moisture absorbed may wrinkle the specimens.

When pressed they may be coated with thin white varnish applied with a fine brush. Another good method is to hold a warm iron upon the leaf for a moment, and then pass a lump of spermaceti over the face. The heat of the leaf will melt the spermaceti, which is a white wax.

Either the varnish or the wax will bring out the colors prettily, and will give an ornamental finish. They may be mounted upon cardboard or sheets of paper with mucilage, or by sticking strips of court-plaster across the stem and tip in the manner shown in the cut. Every specimen mounted for scientific purposes should be analyzed according to the model given on page 48.

HOW TO DRAW LEAVES.

The shapes of most leaves resemble in their outlines some geometric figure, as an oval, triangle, pentagon, etc. First, determine which of these figures will most nearly inclose the leaf to be drawn, and construct the figure of proper size in faint, light lines. Then draw a vertical line through the center, and a horizontal line at the greatest breadth of the leaf. In some figures it will be better to make these lines first. Next, carefully sketch the outline of the leaf, allowing its longest projections to touch the figure. Erase the construction lines, and add necessary details.

It is interesting to study the geometric proportions of leaves. Thus, in the maple the breadth is one sixth more than the length; the base-veins form a right angle with the mid-vein; the side-veins form an angle of 45° with the mid-vein, and consequently a right angle with each other.

In the rose, the first pair of leaflets is at right angles to the petiole, while the second pair is at an angle of 45°, holding the terminating leaflet at the center of their divergence.

HOW TO PAINT LEAVES.

Having sketched the outline of the leaf, apply the paint with a camel's-hair brush, copying the colors from a natural leaf. Those who can not sketch free-hand may trace the outline from a picture. Place tracing or tissue paper upon the picture and go over the outer edge with a soft lead-pencil, then reverse the paper and trace the outline on the other side as it shows through. Place the copy upon the paper to be painted with the side uppermost which was first traced. Go over the edge again with the pencil, and an impression will be made. In painting, care must be taken to cover up the lines. Water-color paints may be bought in boxes from a stationer's or an art store. Oil-paints come in tubes.

Chrome-yellow and Prussian-blue, mixed in equal proportions, make green. Only a very little should be squeezed from the tubes at a time. The shade may be lightened by silver-white. For red shading use vermilion, and for brown veining burnt umber. For painting on paper or satin, it is better to mix in a little megilp.

HOW TO PRINT LEAVES.

Procure some printer's ink in black, green, or red from a printing-office or stationer. Make a pad by tying a ball of raw cotton in a piece of satin or other smooth material, and draw some of the cotton into a handle, sewing the covering tightly around it.

Spread a thin layer of ink upon glass, and ink the pad evenly by pressing it down several times. Place the fresh leaf face downward upon newspaper, and ink the wrong side by pressing the pad lightly upon it. Next lift the leaf by the stem and place it, inked side downward, upon unruled blank paper. Lay a piece of paper over it and rub gently with the fingers. Lift the paper, and then the leaf. Allow the print to dry before being handled.

A pretty wreath may be made by a combination of colors

Printed Leaves.

HOW TO SKELETONIZE LEAVES.

First, get on hand a good stock of patience, and then try the following receipt—the exquisite result will compensate for the tediousness of the process: Dissolve four ounces of washing-soda in one quart of boiling water, add two ounces of slaked lime, and boil for fifteen minutes; allow it to cool, and then pour off the liquid into a clean pan. Boil again, and then put in the leaves and boil them slowly for an hour, adding water to make up for evaporation. Try, under cold water, whether the green pulp is loose; if not, boil a little longer.

Skeleton Leaf.

Then put the leaves in cold water and rub off the green pulp *very carefully* with fingers or brush.

To bleach them, use two tablespoonfuls of chloride of lime dis-

solved in one quart of water and a few drops of vinegar. Leave them in until they look quite white, and then wash in several waters to get the lime out. Dry in blotting-paper under a little pressure.

Willow, maple, chestnut, elm, and rose leaves skeletonize more successfully than others. September is probably the best month for this operation, as the framework attains its greatest strength by that time.

NOTES UPON LEAF-ANALYSIS.

1. It is not necessary to know the name of a leaf in order to analyze it. If the name is found out afterward, it can be added to the analysis.

2. When the leaves of a plant differ very much from one another, two or three may be analyzed; but they should be given the same number.

3. On the blank page opposite each schedule should be placed a printing, drawing, painting, or a pressed specimen of the leaf analyzed.

MODEL FOR LEAF-ANALYSIS.

Name....*Sugar Maple.* **No**.....*1.*

Arrangement....*Opposite.*

Venation....*Net-veined (Palmate).*

Base....*Cordate.* **Apex**....*Acuminate.*

Margin....*Coarsely Dentate.*

Surface....*Smooth above, silky beneath.*

Petiole...*Long and round.* **Stipules**....*None.*

Simple or Compound....*Simple.*

No. of Lobes or Leaflets..*Three to five Lobes.*

Shape....*Palmisected.*

Color....*Reddish Green above, lighter beneath.*

Surface....*Glabrous.* **Duration**....*Deciduous.*

Date....*July 8, 1887.* **Place**... *Chautauqua, N. Y.*

Special Observations.—*The Sugar Maple is a handsome shade-tree. Its sap yields sugar.*

Name_____ No._____

Arrangement _____

Venation_____

Base_____ Apex_____

Margin_____

Surface_____

Petiole_____ Stipules_____

Simple or Compound_____

No. of Lobes or Leaflets_____

Shape_____

Color_____

Surface_____ Duration_____

Date_____ Place_____

Special Observations_____

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